the skin of mice every second day for 5 months at 50% to 75% of the Commissions hazard threshold. After 8 months only 3 of 40 mice only exposed to the skin carcinogen developed skin cancer compared to 18 of 40 mice exposed to both the carcinogen and RF. Thus, RF with the fumes from solder and solvents may be cofactors in the causes for excess brain tumor risk.

10. Some other observed effects reported in epidemiology studies

10.1 In a study of radar workers with 5 to 10 years exposure it was reported there was increased headache, fatigue, and irritability than among controls.[87]

10.2 Reduction by 19% of REM sleep of adult subjects in an experimental sleep laboratory. REM sleep is important for developing memory function and learning processes[47]

10.3 For school children living in front of a radar station, with exposures less than 1/20th of FCC safe limits the children had *"less developed memory and attention, their reaction time was slower and their neuromuscular apparatus endurance was decreased."*[48]

[note: slower reaction time could imply increased traffic accident rates. Indeed, a Russian study of a magnetic fields from changes of the sun found a 17% increase on days with high magnetic fields[49]. While radio frequency is much different than these magnetic fields, together these studies suggest electromagnetic field exposure can slow reaction time and increase traffic accidents.]

10.4 A 6 fold increase in micronuclei (chromosomal fragments/chromosomes not incorporated into daughter nuclei) was found for cows near radar exposures below 1/20th 'safe' FCC levels.[50]

10.5 A review supporting the view of the Ad-Hoc Association has found the U.S. Moscow study (at 9.8), the Korean Naval radar personnel study (at 9.10), other military exposure study (at 9.4) report a cancer RF link; female physiotherapists had about 2 fold higher miscarriages[111].

10.6 Sleep difficulties, pain in joints found in persons near a shortwave station. Sleep difficulties stopped on days when transmitter was turned off, but unknown to study participants.[110]

11. Keeping exposures 'as low as reasonably achievable' (ALARA) as a requirement in the Commission's standard is therefore justified given all of the above and the evidence in the record of this proceeding of adverse effects at extremely low exposure levels.

11.1 NIOSH directs the Commission to put an ALARA requirement in its standard: The Commission is again reminded that comments submitted by David Fichtenberg on October 8,

1996 explicitly noted [at pg. 22-23] the NIOSH directive at 3.1 above that "exposure should be minimized to the extent possible." Please note NIOSH gives this directive in its Jan. 11, 1994 letter in the "General Comments" section where it was among the 3 most central concerns of NIOSH. Moreover, note that even here, of the 3 concerns, the directive "should" was only called forth for stating the protection provided by the standard and the need to minimize exposure, i.e. NIOSH directed the Commission stating,

"The standard should note that other health effects may be associated with RF exposure and that exposure be minimized to the extent possible." [page 1 of R. Niemeier NIOSH letter of Jan. 11, 1994 to the Commission]

Thus, it is not a 'small thing' for NIOSH, but rather, it was the only concern which merited being in the General Comments section and with the directive of what the Commission "should" do. As noted in sections 2 and 3 the views of the other federal health agencies are consistent with the NIOSH directive. And the need for stating in the standard that "exposures shall be kept as low as reasonably achievable" has been urged by the Ad-Hoc Association in its Petitions and many comments and replies in this proceeding. Moreover, given the actual evidence of observed effects at levels far below the hazard threshold of the Commission, requiring that "exposures shall be kept as low as reasonably achievable" must be included in the standard for the Commission to act with prudence and due diligence.

11.2 Recall that it has been noted in this proceeding that IRPA and the State of Washington have included findings supporting the ALARA policy

11.3 Precedence by Nuclear Regulatory Commission establishes ALARA has a prudent, feasible, well-defined, and expected directive to include in federal agency rulemaking regarding electromagnetic radiation exposure. The Commission should adopt ALARA into its standard to be consistent with due prudence practices followed by other federal agencies addressing radiation concerns. Specifically, the Ad-Hoc Association noted the 1983 Nuclear Regulatory Commission ("NRC") rules included ALARA provisions. The Commission should define ALARA as does the NRC [10 CFR §20.1003 (1996), accept for the phrase "in relation to utilization of nuclear energy and licensed materials" substitute, *"in relation to the utilization of radiofrequency for telecommunications"*.

Also, in accordance with the Ad-Hoc Association request that a RF health and safety program be a requirement [at Ad-Hoc Association FCC -96-326 Petition at 17-18] and the request here that it apply to all workers, the Commission should adopt the ALARA principle established by the NRC as part of its radiation protection program, and thereby follow present accepted precedent for federal radiation safety programs and use the same language as in NRC rules which require,

"The licensee shall use, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA)." [10 CFR §20.1101(b)].

In the case of RF radiation protection the "procedures" in the specification above should at least include those specified by NIOSH above and by OSHA so that there would be appropriate procedures specified for assuring a written program, and,

"training, medical monitoring, protective procedures and engineering controls, signs, hazard assessment, employee involvement, and designated responsibilities for program implementation." [OSHA letter of 1994][29]

11.4 Evidence that RF effects may be cumulative further justify ALARA

11.4.1 Note that increased acceleration of skin cancer tumors was reported when mice were exposed 3 months rather than only 1 month prior to the application of a skin carcinogen 3,4 benzopyrene (see above section 7.6). An that in both cases, acceleration of skin tumors was faster than for the sham irradiated controls. Thus, it is clear that past prior exposure had an effect on the acceleration, even though the skin carcinogen was applied after the RF exposure period ended. If there were no cumulative effects, then no differences should have been found. Since effects were found this is evidence supporting RF effects were cumulative. (please note this study was among the 1991 IEEE studies found suitable for standard setting).

11.4.2 At 0.2 W/kg (rough approximation) (5%) Rats were given doses of dextroamphetimine used to treat Attention Deficit Disorder in children, adolescents and adults *"The response rates were notably higher* (too many responses) *after microwave radiation.. even though the last exposure to radiation occurred 24 hours before the drug was administered,"* suggesting a cumulative effect of the irradiation. (Thomas et al, 1979)[22]

11.4.3 NCRP 1986 assumes a cumulative effect could occur over the course of a week, and so uses this rationale to set its general population limits so that the cumulation dose of 24 hour exposure for 7 days will not exceed that allowed for workers exposed for 8 hours for 5 days. (see section 3.2 above).

12. The Commission must not categorically exempt evaluations when out-of-compliance conditions may occur, as requested by the Ad-Hoc Association FCC 96-326 Petition at page 5,6 and elsewhere noted in this proceeding. As previously noted by the Ad-Hoc Association in its FCC 96-326 Petition [at page 5,6], the Commission's categorical exemptions from evaluations does not consider whatsoever the distance of nearby multi-story buildings to tower mounted (non-roof top) transmitters greater than 10 meters and without regard to their power output. The Commission has greatly overlooked or misunderstood the science-based literature on this subject when it stated,

"For antennas mounted higher than 10 meters, measurement data for cellular facilities have indicated that ground-level power densities are typically hundreds to thousands of times below the new MPE limits." [in support of this conclusion the Commission cited the article, "Radio-Frequency Electromagnetic Fields Associated with Cellular-Radio Cell-Site Antennas," by Petersen and Testagrossa, Bioelectromagnetics 13:527 (1992).]

However, the Commission may have overlooked or misunderstood that the authors of the above cited article by Petersen and Testagrossa states, *"Frequently, freestanding towers (monopoles) approximately 45 meters tall are used...*[at page 528] .(and later) *In this study, the electric-field strength was measured near the base of two typical monopoles (45 meters and 50 meters) and two lattice towers (66 meters and 83 meters)* [at page 529]." Therefore, if the Commission is relying upon this study, then the Commission should allow exemptions only if the tower is 45 meters high -the lowest height towers in the article referenced by the Commission. But, more importantly, only 'ground-based' measurements are considered, and not those exposures to which the upper floors of nearby homes, schools, hospitals, or office buildings may be exposed to the typical main horizontal beam of such transmitters, whether an isolated transmitter or a group of them (perhaps on separate nearby parcels with different owners). Thus, as noted in the Ad-Hoc

FCC 96-326 Petition, the Commission greatly overlooks or misunderstands how homes, schools, hospitals or offices can receive 100s or 1000s of times higher exposure for any upper floors near the transmitter and at a close to its height.

Moreover, while it is correct that engineering considerations may seek transmitters that extend over the tops of buildings, the finding of a willing leasor may result in less than optimal locations. Also, transmitters may 'just' exceed the heights of nearby buildings, resulting in their still receiving relatively high exposures. Moreover, local jurisdictions often place height restrictions for aesthetics requirements so that towers may not be much above 10 meters to meet aesthetic concerns - and it is not unusual for a nearby apartment building to be near to 10 meters high.

The Commission's rules should also consider the following

Building 1 Building 2

Building 3 Building 4

where cellular phone service transmitters are on Buildings 1, 2, 3 each under 1000 Watts (say 900 watts ERP), but then the combined exposure of 2700 watts ERP irradiating on a corner of Building 4 could exceed limits if the buildings were close together. For example, if a corner of building 4 were 40 feet from the transmitters of Building 1, 2, and 3, then the exposure from the three main beams upon building number 4 would be (360 x 2700)/(40 feet ^{2}) = 607 microwatts / sq. cm which exceeds the 580 microwatts / sq. cm limit of some cellular services.

Thus, while the Commission must provide clear rules to operators for how to make evaluations, these rules must also assure that any categorical exemption was properly considered. For example, to have considered the possibilities of nearby multi-story buildings - for example consider a residential area in the shape of a square, with a multi-storey apartment building at the 'center-of-the-square' and transmission towers at each corner. The Commission's rules must assure for these and other conditions found in residential and commercial areas that out-of-compliance conditions will not be categorically exempted from measurement - thus allowing the condition to remain undetected.

13. Support OSHA and NIOSH directive to the Commission that an RF safety program is needed for workers to be exposed to 5 fold higher levels. As indicated in 4.7.1 and 4.7.2 above, the Commission's higher tier of exposure should not be allowed without the RF safety program elements required in the Commission's rules as given by OSHA[61,65] in 4.7.2.

13.1 To see that the Commission has misunderstood its jurisdiction consider the rules of the Nuclear Regulatory Commission whose focus is to provide for nuclear power and not to be health agency, even though its rules must have a health and safety component. In this way the Commission has a similar role, responsibility and scope of jurisdiction. Therefore, to see that the Commission has some jurisdiction in this matter and should adopt regulations similar in content and form to the NRC Radiation Protection Programs rules in 10 CFR §20.1101 (a) (b) and (c) and adopt the survey and monitoring rules of the NRC in 10 CFR §20.1501 and 20.1502 of Subpart F, making modifications appropriate for a radio frequency standard, and to include the program element requirements given by OSHA[29]. The role of the Commission is similar to that of the NRC as far as needing to include worker protection rules, but not being a health agency, and the NRC rules have shown that there the Commission, just as the NRC can establish the elements of a radiation protection program. Therefore, it appears the Commission has misunderstood or overlooked the NRC precedence. Now therefore, let the Commission establish in its rules the elements of an RF health and safety program as specified by OSHA[61] and further specify that OSHA or any local or state jurisdiction setting occupational safety standards may apply more stringent local requirements concerning the elements of the RF safety program identified by the Commission than provided for by the Commission.

13.2 The higher tier worker exposure limits must only be allowed if the RF safety program specified by OSHA is in the Commission's rules

The Commission needs to clarify that for occupational exposure limits to apply, that workers *"fully aware of the potential for exposure and can exercise control over their exposure."* only if there is the RF safety program components specified by OSHA are in place for any worker that may be exposed to the higher tier of exposure.

The Commission appears to contradict itself when it stated, "OSHA's suggestion that we use the uncontrolled tier of the ANSI/IEEE standard as the basis for an 'action limit' for establishment of an RF safety program is beyond the scope of our jurisdiction." This is because the Commission specifies that above the limits of the 'uncontrolled tier' there must be in place provisions to ensure that workers are *"fully aware of the potential for exposure and can exercise control over their exposure."* This necessarily implies the limits of the 'uncontrolled tier' is an 'action limit' and that some sort of a RF safety program is established when exposures in the workplace exceed this 'action limit.

Likewise, the Commission seems to contradict itself when it first states *"Our NEPA responsibilities do not appear to encompass the issuance of specific rules on workplace practices and procedures. If such a policy were to be instituted by the Federal government it would seem more appropriate for OSHA itself to promulgate this type of rule"* [FCC 96-326 at para. 33] Yet, elsewhere the Commission decided, that concerning "awareness for the potential for exposure," that *"Warning signs and labels can also be used to establish such awareness as long as they provide information, in a prominent manner on risk of potential exposure and instructions on methods to minimize exposure risk* [FCC 96-326, para 45] *(*in footnote 116: *for example a sign warning of RF exposure risk and indicating that individuals should not remain in the area for more than a certain period of time could be acceptable.)."* This contradicts OSHA's directive to the Commission which stated that "signs" alone are not sufficient to meet the requirement, but rather, are one of a set of required components before workers may be exposed to the higher tier. Likewise, in NIOSH's letter to the Commission (see # above) NIOSH indicates that "control measures, appropriate medical surveillance, training" are needed as well as "hazard communication" (signs). Thus, by the Commission stating signs alone are sufficient, it contradicts the directive of NIOSH which stated that warning signs alone could not meet the requirement. Moreover, EPA stated in its Nov. 9, 1993 letter to the Commission that "awareness in a controlled environment can vary from complete knowledge to almost no knowledge." Accordingly, just because there are signs with instructions, does not mean workers understand

these signs and will respond as directed - some assessment of knowledge is needed, such as part of a training program.

Furthermore, in the Commission's example, it stated it would be acceptable to meet its requirement of workers being "fully aware of the potential for exposure and can exercise control of their exposure" if a warning sign indicated that workers should not stay in the area beyond a certain period of time. Yet, this is no guidance at all and defeats the intent of changing the expression in the NPRM of "awareness of the potential for exposure" to that just mentioned. First, as long as the average over a 6 minute period met the limits of the higher exposure tier, one could argue that workers may be in the area without time limit, and only that the time limit warning would apply when high power densities requiring leaving the area before 6 minutes so that the 6 minute average exposure does not exceed the higher exposure tier limit. Hence, the Commission seems to interpret 'in control' to only mean to assure the higher tier limit is not exceeded, and this interpretation is contrary to the guidance of OSHA which stated that the intent of the warnings and controls should be *"to mitigate any potential increase in risk."* [March 1, 1994 letter from OSHA to the FCC].

By the Commission so stating that warning signs alone are acceptable for meeting the requirement as part of an RF safety program. Warning signs and labels can also be used to establish such awareness ..." [FCC 96-326, para 45]. Hence, the Commission has in fact established the more stringent tier as an "action limit" and requires some RF safety program to be in place, e.g. training or warning signs, to assure workers are *"fully aware of their exposure and can exercise control over their exposure."* Thus, just as the Commission specified that signs may be used to warn of high exposure areas (without specifics as to size, shape, language etc.) so too can the Commission simply state in a single sentence that "can exercise control over their exposure" means that,

"There is on file with the Commission, or available upon request, a copy of the written RF protection program that appropriately addresses traditional safety and health program elements and shall include at least training, medical monitoring, protective procedures and engineering controls, signs, hazard assessments, employee involvement, and persons with

designated responsibilities for program implementation, and the effect of such program shall be to mitigate any potential increase in risk,"

as requested in the Ad-Hoc Association FCC 96-326 Petition at page 17 should be followed, and also that they should apply to locations with any number of exposed workers at risk. Also, as noted in the Ad-Hoc Association Petition, in the rule itself, the Commission can specify that federal, state, and local jurisdictions with units responsible for occupational health may specify what is required to meet the elements given by the Commission, as described above.

Please note fulling the OSHA directive only requires the adding of a few sentences [as described by the Ad-Hoc Association FCC 96-326 Petition at 17] and will not require the Commission to issue "specific rules on workplace practices and procedures" as the Commission misunderstood. [FCC 96-326 at para. 33].

To appreciate the importance of this directive please note it was the sole directive given by OSHA to the Commission. Moreover, please note that specifying the elements of a worker protection program, as requested by the Ad-Hoc Association in this proceeding is a key concern of NIOSH. As noted above, in its 1994 comments to the Commission, NIOSH stressed but 3 key points in its statement of "General Comments," and one of these was, *"In general, the standard provides minimal guidance on control measures, appropriate medical surveillance, training, or hazard communication."* Thus, both NIOSH and OSHA have identified what they find is a major weakness in the standard, and a solution is possible, given above, without the Commission becoming involved in the "issuance of specific workplace rules and procedures." [FCC 96-326 at para. 33].

14. There should be no 'grandfathering' of past RF exposure criteria.

14.1 Evaluations by federal health agencies and studies indicating the Commission's limits may not protect from all RF hazards and should be lower, justifies no 'grandfathering' of exposure rules but that all stations must follow new Commission rules.

As indicated by comments to this proceeding by the Ad-Hoc Association, the Cellular Phone Taskforce and others, the Commission must apply its new rules to all stations. This is

because, as noted above and elsewhere in the record of this proceeding, the federal health agencies have told the Commission that the 0.4 W/kg exposure criteria allowed for all workers (whether aware or not, whether in control or not) and the public is not sufficiently protective, and that the Commission's new rules provide improved protection. Moreover, EPA, NIOSH, and OSHA all strenuously objected to the concept of 'controlled' and uncontrolled' environments. OSHA explicitly stated,

"The possible implication that employees may be subjected to a higher level of risk because they 'are aware of the potential for exposure as a concomitant of employment' is unacceptable to OSHA."

Now consider that many stations now are licensed under the 1982 ANSI RF standard which allows all workers and the public to be exposed to 0.4 W/kg objected to by the federal health agencies and found to be less protective than the new approach of the Commission. Also note that 1992 ANSI/.IEEE has been used to license Personal Communications Services base stations and includes the unacceptable concepts of 'controlled' and 'uncontrolled' environments, where workers can be exposed to the higher levels under conditions "unacceptable" to OSHA Also, EPA says, "We strongly disagree with the use of the concepts of control and awareness in the discretionary manner presented in 1992 ANSI/IEEE.... In our view 'awareness' is not equivalent to protection." NIOSH expresses similar concerns.

Therefore, the standards under which current stations were licensed are not just 'different' but contain elements "unacceptable" to the federal health agencies, and provide limits which EPA suspects does not protect "more susceptible or sensitive people."[Fed. Reg. Vol. 51, No. 146, page 27331, July 30, 1986]. Also, EPA, FDA, and NIOSH indicate that the claims of 1992 ANSI/IEEE that its limits are those "to which a person may be exposed without harmful effect and with an acceptable safety factor," are, as noted by EPA "unwarranted." Hence, allowing standards to continue in force which have these serious defects is dangerous to the health of workers and the public, and certainly not in the public interest. Thus, the Commission must clarify its rules to indicate that all its licensees, whether from new applications or existing licensees must abide by the new guidelines.

14.2 The Commission should follow the precedence established by the Nuclear Regulatory Commission ("NRC") and now do what is considered due prudence for federal agencies setting electromagnetic radiation health and safety rules, and to not allow grandfathering, but that all licensees should follow the new rules. Specifically, the Commission should adopt the language of the NRC pertaining to the scope of stations which must adopt new radiation safety rules [i.e. adopt 10 CFR §20.1008 (b)(c)(d)(e), making appropriate changes for dates, CFR sections, and other similar changes associated with radio frequency vs. ionizing radiation. These rules provide,

"If the requirements of this part (the new rules) *are more restrictive that the existing license condition, then the licensee shall comply with this part unless exempted by paragraph (d) of this section."* [10 CFR §20.1008(b) (1996)]

And paragraph 10 CFR §20.1008(d) (1996) provides,

"If a license condition or technical specification exempted a licensee from a requirement in the standards for protection against radiation in effect prior to (date new rules went into effect), it continues to exempt a licensee from the corresponding provision of (the new rules)."

Note that since new limits are established and the previous limits of the Commission are now only allowed to apply to workers under certain conditions, following the NRC approach all FCC stations would need to be in compliance with the new limits which will also apply to new applicants or renewal applicants. Hence, precedent has been established, and the NRC approach is the feasible, expected, prudent manner a federal agency is to follow when setting radiation health and safety rules, especially when there is evidence as shown above, that the past rules may not be as protective as proposed new rules.

Since (i) the Commission has decided upon and established a policy of setting rules, "out of an abundance of caution79", and (ii) the NRC has set and established what is consider the proper and prudent course for setting health and safety radiation standards, (iii) and the Ad-Hoc Association, the Cellular Phone Taskforce, and other parties in this proceeding have provided evidence that adverse effects have occurred below the Commission's hazard threshold, therefore, to serve the public interest the Commission must apply its new limits recommended by EPA to all of its licensees.

15. Science based studies of disruption of learned behavior or learning of new behavior justify a Commission hazard threshold of 0.15 W/kg. The Commission is urged to review the Ad-Hoc

Association requests that the Commission's hazard threshold be no more than 0.15 W/kg based on well-designed and replicated studies at this level showing disruption of operant behavior (the criteria of 1986 NCRP and 1992 ANSI/IEEE for standard setting), and altogether 4 studies finding disruption of operant behavior at this level21,32,33,34,35 [see above 5.1 and 5.6]. Moreover, while only one of these four studies has formerly been reviewed by IEEE members and found suitable for standard setting, it has been noted that the co-authors of the other 3 studies are highly regarded as key participants in the RF standard setting process [see section 5.4 above], and that prudence provides that these papers should be presumed also suitable for standard setting As has been noted, the 4 studies Also other studies finding disruption of behavior and other adverse effects below the Commission's hazard threshold have been given by the Cellular Phone Task Force, the Ad-Hoc Association, and other parties in this proceeding.

16. The Ad-Hoc Association has provided evidence that the relationship between external exposure and internal rate of absorption used to develop the Commission's power density limits underestimates the true absorption rate such that power density in much of the spectrum needs to be reduced by a factor of two to achieve presently estimated whole body SARs.

16.1 A 1991 IEEE final list paper[98] reviewed and found suitable for standard setting supports the Ad-Hoc Association claim that power density limits need to be reduced by a factor of 2 to 2.5 just to maintain even current whole body average specific absorption rate protections. A study by Hill (1984)[98] gave results from dosimetry studies and provided arguments for making the standard more stringent by setting limits to 1/2 their level in the 1982 RF ANSI standard. Nevertheless the author did not find the need for such reduction because

(i) "the ANSI standard incorporates a general safety factor of 10," (i.e. 1/10th of 4 W/kg)

(ii) "most occupational exposures occur under near-field part body exposure conditions,"

(iii) "the presence of insulating footwear between the feet and the ground."

Given all the above in this ex parte presentation and other evidence in this proceeding, it is shown below that the above justifications are no longer valid, and consequently the limits need to be reduced due to the reported relationships between external exposure and internal rate of absorption. The above 3 justifications are no longer valid because:

(i) "the safety factor of 10 is found insufficient since in fact the hazard threshold of 4 W/kg is too high. 4 studies report disruption of behavior at 0.6 to 0.7 W/kg, i.e. at 15% of the Commission's hazard level. Also more than a 3 fold increase in primary malignant tumors was reported at 0.4 W/kg, the level corresponding to that when a 'safety factor' of 10 is applied to 4 W/kg. Moreover, in this proceeding, adverse effects at even lower levels were reported, e.g. at 0.016 W/kg (1/250th of 4 W/kg) a pathological change occurred in the blood-brain-barrier protecting the brain from large molecules in the blood [Ad-Hoc Association 96-326 Petition at 15][99] (corrected footnote). Therefore, since the evidence in this proceeding supports that the hazard threshold is likely 1/10th or less than 4 W/kg, the 'safety factor' of 1/10th applied to 4 W/kg is no longer a valid consideration.

(ii) The Commission's new limits for the general population are 1/5th the previous general population exposure limits of the 1982 ANSI standard. Also, parties submitting Petitions For Reconsideration in this proceeding have shown concern that due to co-location of transmitters the Commission's limits may be exceeded for the general population. Accordingly, due to both the more stringent limits and the co-location of transmitters at relatively low heights in residential and commercial areas, the general population may be exposed to a whole body exposure at limits 1/5th of that considered by the author above. Hence, the justification that whole body exposures would be unlikely occur near the limit is no longer valid.

(iii) Since limits are 1/5th more stringent such that the general population may now be exposed to the limit, it is noted the general population may walk on the ground without insulating shoes, and so the author's third justification is no longer valid.

16.2 The Commission is urged to review the evidence in a 1992 paper using the FDTD method of O.P.Gandhi[97] show that the relationship between external power density and internal rate of absorption of RF energy needs modifying - allowing recognizing that power densities in the range they are meaningfully related to whole body average SAR cause SARs about 2 to 2.5 fold higher than assumed when developing the standards upon which the Commission's limits are based. [see Ad-Hoc FCC 96-326 petition at pg. 14 (disregard the 11th line from the top, starting with "2.

Avg. SAR of 1 year old ..." - this line should not be there as it is a typographical error as has been noted].

To see that there are valid justifications for the Commission to rely upon the results of Gandhi[97] consider that:

(1) The Commission stated it found the FDTD method valid for the purposes of standards setting [at FCC 96-326 #70, and Ad-Hoc Association 96-326 Petition at 14]

(2) The Commission explicitly named Dr. O.P. Gandhi as a researcher who properly uses this method [at FCC 96-326 #70, and Ad-Hoc Association 96-326 Petition at 14], and

(3) The input parameters used by Dr. Gandhi were the basis of a peer-reviewed paper by Gandhi referenced[100] in the 1992 ANSI/IEEE RF standard which stated, that the paper provides *"An anatomically realistic model of a human being..."*102. Thus, the values for the electrical characteristics for tissues used in this paper and derived from another paper101 are found by the 1992 ANSI/IEEE standard to provide a *"realistic model of a human being."*[102]. Moreover, this same paper was used by Dr. Gandhi in a paper submitted to the Commission[103] as part of his work to further research the FDTD method.

Therefore, the method, the researcher, and the input parameters, have all been found by the Commission, or by 1992 ANSI/IEEE committee members whom the Commission has reported to be experts[104] to be relied upon for standard setting.

That Dr. Gandhi's 1992 paper provides evidence that the Commission's power density limits are too high to provide the assumed average whole body SAR protection see Ad-Hoc FCC 96-326 petition at pg. 14, and Ad-Hoc Association late filed Reply Comments of October 28, 1996 at pg. 7-8, Comments of David Fichtenberg supporting the Cellular Phone Taskforce and dated October 8, 1996 at pages 8-10] To easily see there the Commission's limits must not be appropriate to provide the claimed whole body SAR protection consider the following. That for frequencies after whole body resonance of people the whole body SAR decreases until it reaches a limit where it then tends to remain constant[106], at least to 6000 MHz, after which SAR may not be meaningful as a RF standard criteria[105]. In his 1992 paper[97], Gandhi reports that from about 350 MHz to the

highest frequency studied, 915 MHz that average whole body SAR for E polarization for a typical adult male was approximately constant at 0.08 W/kg per 1 mW/sq. cm. after having decreased from a maximum. Thus, given the above, it can be assumed that at PCS frequencies of about 1900 MHz that the value of 0.08 W/kg per 1 mW/sq. cm. will also apply. However, 1 mW/sq. cm. is the allowed limit for all frequencies about 1500 MHz. But for these higher frequencies children, especially very young children, being of smaller body size are closer in size to the short wavelengths of these frequencies and so have a higher average whole body SAR[106]. Now, since it is estimated that at 1900 MHz and at 1 mW/sq. cm the average whole body SAR is 0.08 W/kg for an adult male, it must necessarily be higher for a young child. But 0.08 W/kg is the upper limit for the average whole body protection for which the Commission's limits are to assure is not exceeded [see NCRP 1986, 17.4.2]. Thus, the power density limits given by NCRP 1986 and 1992 ANSI/IEEE are too high, having been decided upon before the 1992 research paper of Gandhi[97] was published in a well regarded peer-reviewed journal, Health Physics.

Since the Commission has wisely decided that its rules should "provide assurance that recent scientific knowledge is taken into account..."[71] it should apply the findings of Gandhi and Hill (1984) and reduce its power density limits, so that based on the more recent science-based findings, the average whole body SAR limits can best be assured not to be exceeded.

Finally, consider that doubt there will be those scientists who say that Gandhi's method is a computer simulation and may not be valid. While this may be so, prudence, the Commission's policy of practicing "an abundance of caution"79, the Commission's past decisions that Gandhi's method, his work, and parameter values are reasonably realistic and can be used for standard setting, all argue that these results are appropriate for justifying having more stringent power density values.

17. The Commission is urged to clarify it comments in the FCC 06-326 that its preemption does not apply to the "operation" of its licensees, and in particular to the setting of RF exposure limits, per requests of the Ad-Hoc Association FCC 96-326 petition at pg. 13, 14, and also see David Fichtenberg opposition to Ameritech Mobile Communications request to also preempt "operation" of personal wireless services facilities, dated Oct. 8, 1996 [at pages 3, 9-23)]. Claims

by others that Congress found it was unnecessary to state 'operation' are not sound. As noted by the Ad-Hoc Association in its October 8, 1996 comments, the Joint Senate/House Committee removed the word 'operation' from the House version of the bill (HR 1555). Yet the Joint Committee stated the limitations on the powers of the Commission in Sect. 704 of the Telecommunications Act of 1996 "are not intended to limit or affect the Commission's general authority over radio telecommunications, including the authority to regulate the construction, modification, and operation of radio facilities."[107]

18. Public health policy should not require the same level of proof as when establishing scientific fact:

When seeking advice from the federal health agencies, the Commission should not ask for advice based on what has been scientifically conclusively proven, but rather, given the evidence which exists and the remaining uncertainties, would prudence, and due diligence, indicate that more restrictive limits are indicated. In this regard the Commission is requested to carefully consider that its rules may be found to preempt local jurisdiction rules pertaining to the placement, construction, and modification of personal wireless services facilities, and as such, it will be deciding upon the extent to which the homes, office buildings, schools, and hospitals in the nation are exposed to RF fields. Also, consider that neither the Commission nor the federal health agencies are seeking to establish with scientific certainty the relationships between health and well being and long-term chronic exposure to low irradiation levels of RF fields. For scientific certainty may require much more evidence than prudence and due diligence indicate for establishing RF exposure levels when there is some, yet inconclusive, evidence that certain exposure levels are associated with harmful health effects.

19. The Commission has overlooked or misunderstood the requirements of the National Environmental Policy Act (NEPA) when the Commission selected its RF health and safety rules, and needs to add additional considerations with respect to RF exposure criteria to meet the requirements of NEPA. NEPA requires that any Commission action deemed to have a significant effect on the quality of the human environment requires the preparation of a Draft Environmental Impact Statement and Final Impact Statement [47 CFR §1.1305].

19.1 Fear is a detriment to the quality of the human environment

One of the central elements in the quality of the human environment in residential areas, schools, hospitals, and office buildings, is the ability of occupants of these areas to work, live, study, and recover from illness without being fearful of the potential adverse effects of radio-frequency when they occur at levels which would exceed traditional protection limits (given as 1/100th of a threshold effect [in EPA Vol 51, No. 156, pg] to protect against adverse effects which have been observed in cell-culture, in animals, or in human populations - and even if under circumstances where the studies were not optimal, not replicated and uncertainty persists. Under such circumstances, it may be understandable that scientists will declare that conclusive proof of harm is lacking.

Nevertheless, the existence of these studies as has been documented in this proceeding by the Ad-Hoc Association, the Cellular Phone Taskforce, and other parties, is such that an increasingly knowledgeable public does not want to be exposed to such levels of radio frequency and can be expected to be fearful of such exposure until the observed effects are determined to be spurious, and not reflective of real effects. For example, the Ad-Hoc Association FCC 96-326 Petition submitted a letter from the New Zealand Ministry of Education indicating that they decided, *"However, of paramount importance to the Ministry is the provision of an environment where boards of trustees, parents, teachers, and pupils and other occupants of the school site can feel comfortable. For this reason the Ministry has decided cellphone transmitters will not be sited on Crown owned school sites in the future."*

For the Commission to clearly understand that public concerns are indeed founded upon the science based literature, consider the report by V. Belokrinitskiy referenced in the Ad-Hoc Association FCC 96-326 Petition [at page xxx, footnote xxx, and full article in the Ad-Hoc Petition attachments]. It was among the final list of papers that the experts of the IEEE 1991 committees found well done and suitable for standard setting. The study reported what the author viewed as adverse changes in parts of the brains of rats at levels of 10 microwatts per square centimeter at wave length exposures of 12.6 cm (2380 MHz). The Radiofrequency Radiation Dosimetry Handbook indicates that the highest average whole body SAR for any size

rat at this exposure level is no more than 0.4 W/kg for 1 mW/sq. cm; thus, at the reported exposure the average whole body SAR at which the adverse effect was reported is 0.004 W/kg. This is 1/1000th of the 4 W/kg selected by the Commission. Thus, based on this study and assuming safety factors remain the same as adopted by the Commission, then there would be bona fide justifications for persons to feel fearful if RF exposures exceeded 1/1000th of the Commission's present limits for the region where SAR is meaningful. While it is recognized that perhaps the study has not been replicated, the fact that it has been determined to be a well done study showing what the author considers adverse effects at a very low level, justifies a basis for a reasonable person aware and knowledgeable about the scientific studies to be fearful of exposures which would exceed protection limits based upon the above Belokrinitskiy (1982) paper.

Accordingly, the Commission must ask itself if the available science based findings in the literature, such as the Belokrinitskiy (1982) study above, are such that a reasonable and knowledgeable person of the RF science based literature could feel fearful of the RF exposure limits the Commission might set. This is because while scientific evidence may not be compelling or conclusively prove an adverse effect, the evidence may be sufficient to establish that actual studies considered well done have found associations between RF and adverse effects. Since such fear can strongly impact the quality of the human environment, and even drive people to move their residences, cause strife in schools and the workplace, and dramatically depreciate the value of residential and commercial real estate, the Commission must acknowledge that studies which find effects at low levels strongly impact on the quality of the human environment, at least through the reasonably based fears they can cause. Accordingly, to meet the requirements of NEPA the Commission must consider whether its exposure limits are stringent enough so that when applying a "reasonable and knowledgeable person" test, the Commission finds that such persons will not be fearful to work, study, recuperate from illness, live, or sleep at such exposure levels. The Ad-Hoc Commission claims that such levels can only be achieved by at least decreasing the Commission's limits to 1/100th of the whole body average SAR associated with the effects found based upon the Belokrinitskiy (1982) study and other very low level RF effects

studies documented by the Ad-Hoc Association, the Cellular Phone Taskforce and other parties in this proceeding.

19.2 Radio frequency Interference to non broadcast related devices is a detriment to the quality of the human environment.

The Ad-Hoc Association has also given evidence in this proceeding that interference may occur to sensitive medical devices and hearing aids. This also adversely affects the quality of human life, and may even result in fatal accidents. Indeed, it has been reported that,

"60 infant deaths went undetected by one model of an apnea (breathing cessation) monitor in the United States. This occurred over a period of a few years. It was shown subsequently that this model was extremely susceptible to interference from fields produced by mobile communications base stations up to 100 meters away, and by FM radio broadcast stations over one kilometer away....The most RFI-sensitive model failed in an unsafe manner when exposed to field strengths as low as 0.05 V/m in the 88-108 FM radio broadcast band."[108] Moreover, it has been noted that newer medical devices have been more sensitive to radio frequency interference due to their using low-power integrated circuit technology[108].

Accordingly, since RF interference had occurred as low as 0.05 V/m, the Commission should stipulate that to protect life, that before a facility is constructed a telecommunications operator needs to notify persons who may be exposed to as low as 0.05 V/m of the possible danger of RF interference, and to act accordingly.

Also, 47 CFR §22 should be modified so that operators which cause interference to non FCC licensed equipment, such as medical devices, that it is the operators responsibility to pay for the necessary corrections, since it is the operator who caused the interference.

20. Assure no Constitution Amendment violations: Finally, the Commission may have overlooked or misunderstood that exposure levels of RF which could initiate a reasonable scientifically based fear (as noted above) which could then affect the use and purposes to which a party purchased a property. It seems there is a basis for a 5th or 14th amendment "taking" if there can be expected a reducing the value and use of the homes, as well as using the radio waves in the

home and physically entering the bodies of its inhabitants. For example, the peer-reviewed research paper of Mann et al (1996) provided evidence that radio signals similar to that used for some cellular telephones 'take' about 18% of an adults REM sleep [see Ad Hoc Association FCC 96-326 Petition at ,and at footnote]. Since REM sleep may be important to memory and learning functions, and while it may not be conclusive that a reduction in REM sleep is harmful, this REM sleep 'belongs' to individuals, and 'taking' it without their consent or without compensation by applying a federal preemption rule is a 'taking' under the 5th amendment, and if done by states then it is a taking under the 14th amendment. Hence, while the Telecommunications Act of 1996 may have properly delegated responsibilities to the Commission, the Commission must assure that its RF exposure limits do not provide a basis for a reasonable scientific based fear which could thereby affect the uses of property and constitute a 'taking' of that property as so require a court to stay the preemption authority of the Commission. Consider the following:

"the Court as well decided long ago that 'taking' included destruction or severe impairment of use [Pumpelly v. Green Bay Co. 13 Wall. (80 U.S) 166, 177-178 (1872), Welch v. Swasey, 214 U.S. 91],

and it now holds that,

"property is taken in the constitutional sense when inroads are make upon an owner's use of it to an extent that, as between private parties, a servitude has been acquired either by agreement or in course of time." [United States v. Dickinson, 331 U.S. 745, 748 (1947)].

Consider various Supreme Court and Federal Appeals Court rulings on the "taking" of property. The Supreme Court has ruled that owners of adjacent land deserved compensation because *"noise, glare, and fear of injury"* and other impacts resulted in the adjacent land becoming unfit *"for the use to which the owners had applied it."* [see United States v Causby et al 328 U.S.256, and see Griggs v Allegheny County 369 U.S. 84 because of perceived "noise, vibrations and danger"], and ruled,

"While Congress may legalize, within the sphere of its jurisdiction, what otherwise would be a public nuisance, it may not confer immunity from action for a private nuisance of such a character as to amount in effect to a taking of private property for public use."

and compensation is due under the 5th Amendment. Richards v Washington Terminal Co. 233 U.S. 546.

Thus, it has been demonstrated that there is evidence of a 'taking' of REM sleep[47], and evidence provided by the Ad-Hoc Association, David Fichtenberg, the Cellular Phone Taskforce, and other parties that there is evidence of other adverse effects and biological effects found associated with radio signal exposure levels below the hazard threshold of the Commission. This evidence to either provides a justified basis for a reasonable, science knowledgeable person to have a legitimate bona fide fear of being in the presence of exposure levels allowed by the Commission - such 'fear of injury' can 'take away' the use for which the residential owners of a home had applied to it when the home was purchased.; also, the evidence presented in this proceeding may also be evidence for actual adverse health effects which 'take' health from people, or if just a 'biological effect' then the effect constitutes the taking of control over one's body from persons. In any case, all of these takings are not allowed under the Constitution without compensation.

21. Concerns about radio signal exposure are mainly limited to the new telecommunications services: The Commission should not think that because for years the population has been exposed to radio signals from TV or commercial radio that the above 'takings' concern would have widespread application to these types of signals. There are very important differences.

(1) Recently new telecommunications services transmitters are at low heights in residential and commercial areas thereby resulting in relatively high exposures. Because now telecommunications transmitters are being placed on roof-tops and low height monopoles (but above 10 meters) the upper floors of homes, schools, and office buildings are exposed to higher power densities not far from the typical horizontal main beam - this does not typically occur for commercial TV and commercial radio signals. For example 95% of the U.S. population was reported in 1986 by the EPA to be exposed to less than 0.2 microwatts per sq. cm. Whereas, persons working or living in upper floors near cellular phone, PCS, or other recent telecommunications services when the transmitter is at low height, such as on roof-tops are subject to 20 microwatts per sq. cm. and greater [see Ad-Hoc FCC 96-326 Petition exhibits], which is over 100 fold the exposure level of 95% of the U.S. population reported in 1986 and given above.

(2) Many of the new telecommunications services are in the range of 300 MHz to 3000 MHz which cause hot spots in the body - this does not occur for signals from AM, FM radio, and common VHF TV. The International Radiation Protection Association (IRPA) 1988 RF guidelines report in its Appendix 1 the characteristics of a 'hot spot' range giving the range as,

"The 'hot spot' range, extending from about 400 MHz up to 2000 MHz or even to 3000 MHz...," that, *"The size of hot spots ranges from several centimeters at 915 MHz to about 1 centimeter at 3000 MHz,"* and, *"For the human head, the hot spot range extends from 300 MHz to 2,000 MHz."* [IRPA 1988 RF standard, Appendix 1, Frequency ranges]

(3) The new digital communications services have provided evidence of biological effects which may be detrimental, and to which human populations were not typically previously exposed. Consider, the following:

"Biological effects have been observed at RF (radio frequency) and MW (microwave) fields amplitude modulated at ELF at SAR levels below the threshold for effects for continuous waves. Many of these effects are the same or similar to effects observed for ELF electric and magnetic fields. The observed effects are usually field frequency and intensity specific, tend to occur within relatively narrow ranges of both field parameters, and are dependent on other physical and physiological characteristics of the exposed biological system. Many of these parameters have not been fully identified and characterized. The interaction mechanisms remain unknown. The scientific database is relatively limited in this area. However, the potential importance of these effects should not be overlooked for two reasons. First, the scientific evidence with respect to health effects of ELF fields while still inconclusive, is suggestive of possible detrimental effects. Second, until the recent developments in digital communication, hardly any situations of human exposure to RF/MW fields deeply amplitude modulated at ELF occurred. This situation is going to change rather rapidly with expansion of wireless digital communications". [M.A. Stuchly, "Evaluation of Electromagnetic Fields in Biology an Medicine," in Radiofrequency Radiation Standards: Biological Effects, Dosimetry, Epidemiology, and Public Health Policy, NATO Advanced Science Institutes Series Vol. 274, pg. 327-335, Plenum Press, 1995]

Therefore, because of the above 3 factors: (1) closeness to where people live and work, (2) wave lengths that cause hot spots, especially in the head, and (3) digital signals, the concerns of the Ad-Hoc Association pertain much more to the new telecommunications services that to historical, non-digital TV and AM and FM commercial broadcast services.

Because, these services can cause hot spots in the head, and because their energy absorption is concentrated in the first inch or so of the body (where the cerebral cortex is located), RF effects may especially occur due to slight stimulation of the central nervous system, and thereby stimulate the neuroendrocrine system, and the bodies hormonal and circadian rhythms that are part of these

systems. That there is evidence, as given in this proceeding that brain EEG readings and REM sleep[47] are affected by extremely low power densities, further supports evidence that these effects can and do occur.

Thus, there are reasonable, science based fear of injury concerning these new telecommunications services, and the Commission must assure that exposure levels are such that during this current period of uncertainty of extent of effects that the public health is not put at risk, and that there is not an unconstitutional 'taking' of property and personal control over one's person due to RF effects or reasonable science based fear of injury from such effects.

22. The Commission must make every effort through its rules and abilities to advise the Congress and the President, of the need to explore means of keeping exposures as low as reasonably achievable. This can be done as follows:

(1) Hold the telecommunications industry to their own claims of how low exposure can be kept. In the document, "Health and Safety: A Cellular Telecommunications Perspective" [filed as evidence in a cell site proceeding with the City of Mercer Island, Washington, and per letter of Feb. 3, 1995 in the exhibits of the Ad Hoc Association FCC 96-326 Petition], it states that the highest conceivable SAR due to cellular facilities to be "200 times below the maximum permissible exposure limit set by NCRP." [page 9]. Thus, those transmitting personal wireless services signals can reasonably be held to this limit without causing undue burden.

(2) The Commission reports in its Fact Sheet #2, Sept. 17, 1996, concerning exposure levels from transmitters close to residential areas that studies show exposure levels to be *"typically thousands of times below the levels considered to be safe...*(by IEEE 1991 or 1986 NCRP RF standards) [Question #17, pg. 11]. The Ad-Hoc Association disputes these findings, and believes they do not address exposures from low height transmitters to the upper floors of buildings, and has given evidence in this proceeding to support this. Yet, if the Commission finds otherwise, then to keep exposures as low as reasonably achievable, let the Commission require exposure limits for personal wireless services in residential and commercial areas to be "thousands of times" (e.g. at least 2,000 times) below its present maximum allowable limits.

(3) Encourage satellite and high altitude transmitters in lieu of ground based stations: The Commission should enact measures so that transmitters are placed far from commercial and residential areas. To this end, besides assuring satellite transmitters are used to the maximum extent possible, the Commission should take note that Japan's Ministry of International Trade and Industry has been developing,

"a solar-powered, remotely piloted airship. Earlier this year (1997), the ministry pilot-tested one such cruiser, which resembles an egg-shaped zeppelin with a finned tail. Designed as an inexpensive replacement for communications satellites, this vehicle can continuously ply the skies at an altitude of about 100,000 feet (about 20 miles) for periods of up to 2 years." [Science News, January 11, 1997, page 29]

While the Ad-Hoc Association does not have telecommunications engineering expertise, it would seem that for transmitters only 20 miles high, that local areas would be able to be served, and frequencies shared between areas. This may especially be so if signal transmission patterns and encoding schemes are used for which overlapping signals of the same frequency do not cause interference.

Such 20 mile high transmitters may be more expensive to maintain than those on roof-tops. Yet, until the safety or lack thereof, of the new signal patterns and higher exposure levels is well understood, precautionary measures, including requiring high altitude transmitters in lieu of ground base stations should be strongly considered by the Commission. For while placing controls instead of allowing total 'free enterprise', the Commission will be assuring it is doing its best to protect the public health and public interest - yet at the same time providing a means for the benefits of wireless communications to be realized. Thus, the Ad-Hoc Associations requests do not preclude the development of the benefits of wireless telecommunications. They do however, urge prudence and extreme caution while the many disturbing findings of adverse effects below the Commission's hazard threshold are studied and carefully understood, while during this time the Commission is practicing prudence based on observed studies, so as to best proved the public protection from potentially harmful RF fields.

23. The Commission should state in its rules that there is nothing in its rules that prevent states or local jurisdictions from levying reasonable fees or special taxes on users of personal wireless

services in order to finance studies and research concerning potential adverse health affects from RF. This recognizes the finding of the Office of Technology Assessment that,

"Long-term monitoring of the effects of radio frequency exposure on humans may be necessary to avoid surprises and persistent public uncertainty."

24. Footnotes

1. Action For Children's Television v FCC, 564 F.2d 458 (1977) at 468-469, and additional references cited therein.
2. M. Repachioli et al., "Lymphomas in Em-Pim1 Transgenic Mice Exposed to Pulsed 900 MHz Electromagnetic Fields," Radiation Research, Vol. 147, 631-640 (1997)
3. "Air Force Microwave - Cancer Study Shrouded in Mystery" March/April 1997 Microwave News, pp 1, 13-15. Report of research by J. Toler. The article reported that after 19 months of exposure to 0.32 W/kg that of 200 exposed mammary tumor prone mice, that 115 had palpable abnormalities (and presumably were most likely tumors) vs 88 of 200 controls. This yields the following table:

Mouse had palpable abnormality	Exposed	Control
No	85	112
Yes	115	88
Total	200	200

Applying a classical Chi Square test to this data shows the likelihood of this positive association between exposure and cancer to have occured by chance to be less than 1%.

Note that Szmigielski (footnote 23) found that 18 of 40 breast cancer prone mice exposed to RF had tumors after 8 months of exposure vs. 3 of 40 sham irradiated mice. However, after 10 months 32 of 40 exposed vs. 14 of 40 sham irradiated had tumors. Thus, it is seen that for breast cancer prone mice, if RF does accelerate tumor development, the more sensitive time period for detecting an effect may be an earlier rather than a later time period (since almost all mice are expected to have breast tumors evenetually). Thus, the cancer distribution at the end of the study may not be as senstive to detecting acceleration effects, as at an earlier time period. Hence, results at 19 months was analyzed instead of results at the close of the study.

4. V. Vorobyov et al, "Effects of Weak Microwave Fields Amplitude Modulated at ELF on EEF of Symetric Brain Areas in Rats," Bioelectromagnetics 18:293-296(1997). Effects on EEG during sleep were noted at 0.3 mW/sq. cm. which corresponds to at most 0.3 W/kg per Durney, The Radiofrequency Radiation Dosimetry Handbook, 1986. 0.3 W/kg is about 8% of 4 W/kg.
5. L. Penafiel et al., "Role of Modulation on the Effect of Microwaves on Ornithine Decarboxylase Activity in L929 Cells," Bioelectromagnetics 18:132-141 (1997). Reported exposure was 2.5 W/kg which is 63% of 4 W/kg.
6. H.Dolk et al (1997a) "Cancer incidence near Radio and Television Transmitters in Great Britain, 1. Sutton Coldfield transmitter," American Journal of Epidemiology Vol: 145, No. 1, January 1, 1997:1-9
7. H.Dolk et al (1997b) "Cancer incidence near Radio and Television Transmitters in Great Britain, II. All High Power Transmitters," American Journal of Epidemiology Vol: 145, No. 1, January 1, 1997:10-17.